

OCTOBER 2001

**TANK BATTALION STUDY
FINAL REPORT**

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

**DEPARTMENT OF ARMY
US ARMY ARMOR CENTER
FORT KNOX , KENTUCKY
40121-5215**

20011023 036

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 12-Oct-01		3. REPORT TYPE AND DATES COVERED Final 12-Oct-01	
4. TITLE AND SUBTITLE Tank Battalion Study				5. FUNDING NUMBERS	
6. AUTHOR(S) Lindow, David CPT; Russell, Thomas; Vowels, Lawrence					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Armor Center Ft Knox, KY 40121-5000				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited				12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 words) The Tank Battalion Study is an analytical evaluation using the Close Combat Tactical Trainer (CCTT) at Ft Knox Ky. The tested alternative structures are the 4 company, 3 platoon, 3 tank per platoon and the 3 company, 3 platoon, 4 tank per platoon battalion configurations. The study centered around a tank battalion, with one company of manned tank simulators combined with Semi Automated Forces, making a deliberate attack in an open desert and a visually constrained central European scenario. The threat systems consisted of one to three mechanized rifle companies in a deliberate defense. Doctrine, Training, Leadership, Organization, Material and Soldiers considerations are also included in this evaluation					
14. SUBJECT TERMS CCTT, Close Combat tactical Trainer, 3 versus 4, three tanks versus four tanks, tank platoon, simulation				15. NUMBER OF PAGES 38	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL		

NOTICES

DISTRIBUTION STATEMENT

Approved for public release; distribution is unlimited.

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.



Tank Battalion Study

STUDY GIST

THE REASON FOR PERFORMING THE STUDY was to evaluate the combat effectiveness of the three company battalion, three platoon company, four tank platoon versus the four company battalion, three platoon company, three tank platoon.

THE PRINCIPLE RESULTS OF THIS EVALUATION are that there are no combat effectiveness differences between a battalion with three tanks per platoon, four companies, and a battalion with four tanks per platoon, three companies.

SCOPE this evaluation focused on a company of manned tank simulators with the rest of the battalion be represented by Semi Automated Forces (SAF). The battalion consisted of two or three pure tank companies and one company of Mech Infantry. Each alternative was evaluated conducting a deliberate attack in a desert terrain and a central European terrain.

THE STUDY OBJECTIVES were to determine most force effective construct of the Tank Battalion. To determine the difference in agility exhibited in each alternative. To compare the operational dispersion between the alternate force structures. To examine the fire power differences between the two alternatives. To determine the operational tempo of the alternate force structure. To determine the doctrinal implications of each alternative. To determine the training impacts for each alternative. To examine the soldier / leadership impacts in each alternative.

THE BASIC APPROACH used to accomplish this evaluation consisted of examination of combat capabilities of each alternative within the man in the loop simulation of the Close Combat Tactical Trainer facility at Fort Knox ,Ky.

THE STUDY PROPONENT / AGENCY was the United States Army Armor Center.

Contents

SF298.....	i
Notices.....	ii
Study Gist	iii
Table of Contents	iv
List of Figures	v
Introduction.....	1
Evaluation Objectives.....	1
Equipment Description.....	1
Evaluation Scope.....	2
Alternatives.....	3
Methodology.....	4
Analysis.....	5
Doctrinal Assessment.....	15
Leadership / Soldier Assessment.....	15
Conclusions.....	17
Recommendation.....	17
Appendix A. CCTT Report Headers.....	A1
Appendix B. Historical Bibliography.....	B1
Appendix C. Questionnaires.....	C1

List of Figures

Alternative 1 (3-3-4).....	3
Alternative 2 (4-3-3).....	4
Simulation Run Matrix.....	5
Force Exchange Ratio.....	7
Number of Blue Tanks Surviving.....	8
Tank Companies Remaining Combat Effective.....	8
Tank Platoons Remaining Combat Effective	9
Battalion Frontage	10
Manned Tank Company Kills	11
Shots Fired by Manned Platoon.....	11
Time to Complete Mission.....	12
Movement Rate	12
3-3-4 Desert Ending Combat Status	13
4-3-3 Desert Ending Combat Status.....	14
3-3-4 Europe Ending Combat Status	14
4-3-3 Europe Ending Combat Status.....	15
Leadership Requirements.....	16
Current NCO Progression Pyramid (3-3-4)	16
Proposed NCO Progression Pyramid (4-3-3)	17

Abstract

Tank Battalion Study

The Tank Battalion Study is an analytical evaluation using the Close Combat Tactical Trainer (CCTT) at Ft Knox Ky. The tested alternative structures are the 4 company, 3 platoon, 3 tank per platoon and the 3 company, 3 platoon, 4 tank per platoon battalion configurations. The study centered around a tank battalion, with one company of manned tank simulators combined with Semi Automated Forces, making a deliberate attack in an open desert and a visually constrained central European scenario. The threat systems consisted of one to three mechanized rifle companies in a deliberate defense. Doctrine, Training, Leadership, Organization, Material and Soldiers considerations are also included in this evaluation.

TANK BATTALION STUDY

1. INTRODUCTION.

- a. In July 2001 Major General Bell tasked the Directorate of Force Development at Ft. Knox Ky to review the organizational construct of the tank platoon. The requirements were as follows:
 - (1) Review the organizational construct of current tank platoons and battalions.
 - (2) Develop the resource impact and requirements
 - (3) Determine the personnel impacts
 - (4) Make this a war fighting issue
- b. This report details the conduct of the ensuing war fighting evaluation and the insights gained. The recommendations of this report shall be based on the results of the war fighting evaluation and the resource impacts as provided by Directorate of Doctrine and Training and the Office of Chief of Armor at Ft Knox, Ky.
- c. The Directorate of Force Development in concert with personnel from the 16 CAV and Directorate of Doctrine and Training conducted this evaluation at the Close Combat Tactical Trainer facility during the periods 24- 28 August 2001 and 4-7 September 2001. A system of M1A2, M1A1 and M2A2 BFV simulators was used to simulate combat vehicle operations of battalion level on two sets of terrain to gain insights into the construct of the tank battalion.
- d. Determine the personnel impacts in each alternative force structure.

2. EVALUATION OBJECTIVES.

- a. To determine most force effective construct between the two alternative tank battalion structures
- b. To determine the difference in agility exhibited in each alternative.
- c. To compare the operational dispersion between the alternate force structures.
- d. To examine the firepower differences between the two alternatives.
- e. To determine the operational tempo of each alternate force structure.
- f. To determine the doctrinal implications of each alternative.
- g. To examine the soldier / leadership impacts in each alternative.

3. EQUIPMENT DESCRIPTION.

- a. The tank battalion study utilized the simulation capabilities of the Close Combat Tactical Trainer (CCTT) at Ft Knox, KY. They include the initial positioning and control facilities, the vehicle simulators with LAN based networking, FM (SINGARS) radio networking and in the case of M1A2 simulators, IVIS capabilities. Data collection was accomplished by utilizing one of five AAR rooms which consisted of a number of display monitors, four FM radios and hardware necessary to retrieve the output from the automated data logging capability of the CCTT.
- b. The specific equipment used in the evaluation is as follows:
 - (1) Nine M1A2 Simulators

- (2) Four or five M1A1 Simulators (depending on alternative platoon structure)
- (3) One M2A2 Bradley Simulator
- (4) The remainder of the forces are provided by the Semi Automated Forces (SAF) capabilities of the CCTT which include the control and communications facilities necessary for the platoon leaders and the red force commander to control their respective (SAF) assignments.
- (5) One display that provided the planar view of red and blue forces on a topographical background.
- (6) Four FM radios tuned to the company and battalion networks
- (7) Master control console for initial loading, positioning and general CCTT simulation operation.

4. EVALUATION SCOPE.

- a. The tank battalion study was designed to give insights into a combined arms task force of battalion size by focusing on the number of tanks in the tank platoons and the number of companies in the battalion. The evaluation focus was primarily on the combat effectiveness of the one tank company in the manned tank simulators. In addition to the tank company being located in the manned simulators, the task force commander and all company commanders were also in simulators. Platoon leaders that were not located in simulators were in the control room with a CCTT operator who moved the entities (SAF) according to the platoon leaders instructions. SAF platoon leaders were linked to their respective company commanders via FM radio. This evaluation employed either tank pure or mechanized infantry pure company against a mixed threat. All threat systems were SAF and were controlled by a CCTT operator under the direction of the red force commander, typically a captain from the AOC.
- b. This evaluation is based on a deliberate attack by the task force on either a desert terrain (NTC) or a heavily wooded central European terrain. The choice of scenarios were limited by available CCTT data / terrain sets. Missions were continued until either the blue force had been attrited to sixty-percent of its original vehicle strength, or the red force had been attrited to fifty - percent of its original vehicle strength. A vehicle was recorded as killed upon the first combat hit that registered as either, a mobility, a firepower or a catastrophic type of kill. Non combat kills (vehicle accidents) were restarted and required to catch up with their parent unit. The scenarios were designed so that the manned tank company was placed in the most difficult portion of the battle in order to better discern any difference in combat effectiveness.
- c. The limited number of iterations for each alternative was constrained by time available at the CCTT facility and available tank crews. The limited number of iterations made the quantitative results sensitive to the extremes in output.
- d. The troops participating in the evaluation consisted of two classes from the Armor Officer Basic course comprising the platoon leaders and vehicle

crews, and two groups of students from the Advanced Officer Course who constituted the company commanders. The platoon assignments were rotated among the members of AOB class on a mission by mission basis. Each of the classes participated in one half of the experiments. All participants were new in their assignments and had never worked as an organic unit or crew prior to this evaluation.

5. ALTERNATIVES.

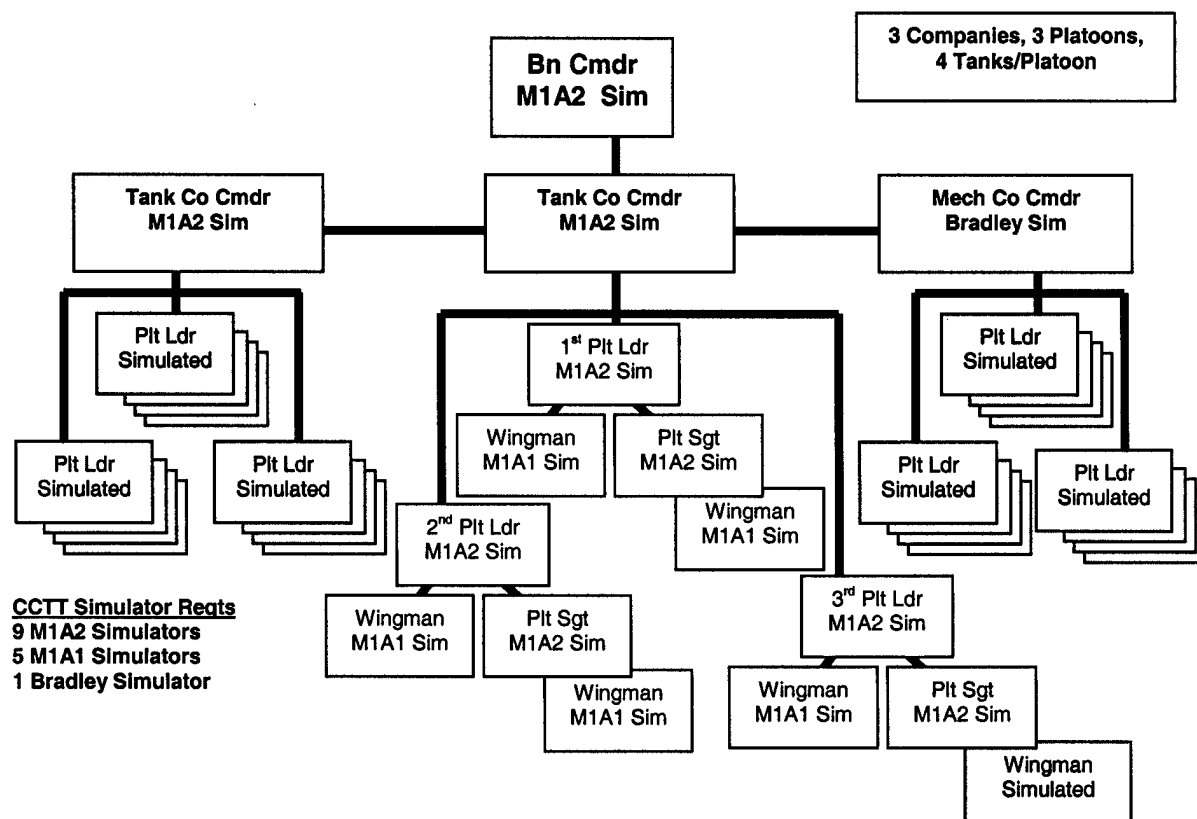
a. The Tank Battalion Study evaluated two alternative force structures. The two force structures are as follows :

- (1) The battalion consisted of three companies (2 tank, 1 Mech. infantry), three platoons in a company and four vehicles in a platoon (3-3-4).
- (2) The battalion consisted of four companies (3 tank, 1 Mech. infantry), three platoons in a company and three vehicles in a tank platoon (4-3-3).

The mechanized infantry company retained its four vehicle makeup in the 4-3-3 alternative.

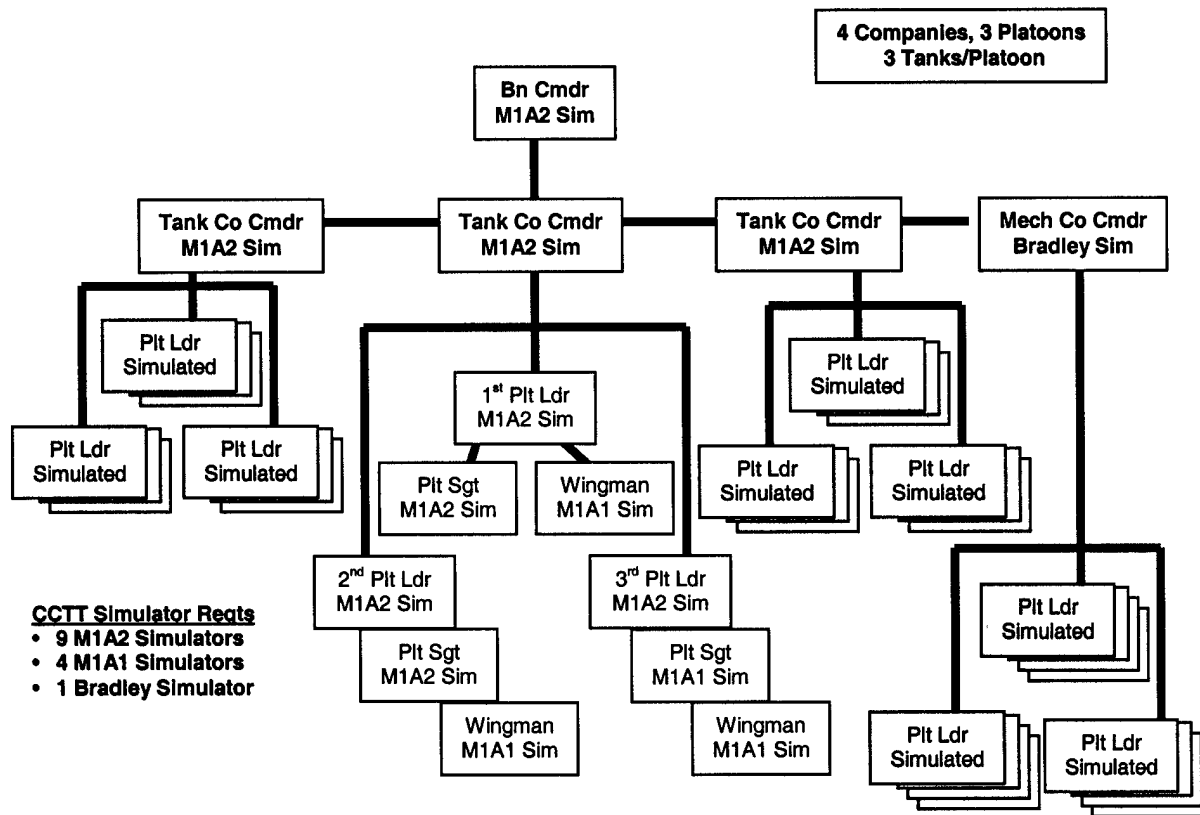
b. The 3-3-4 alternative is graphically depicted in figure 1. The assignment of simulators is also depicted, showing both the task force commander and all company commanders in simulated vehicles. In this alternative, one wingman of the third platoon of the manned simulators was a SAF entity which was tethered to the PLT Sgt's Tank. The platoon leaders and the vehicles they commanded in the SAF companies are depicted as grey.

Figure1. Alternative 1 (3-3-4)



The 4-3-3 alternative is graphically depicted in figure 2. The assignment of simulators is also depicted, showing both the task force commander and all company commanders in simulated vehicles. The platoon leaders and the vehicles they commanded in the SAF companies are depicted as grey.

Figure 2. Alternative 2 (4-3-3)



6. METHODOLOGY.

- The methodology used to accomplish this evaluation is limited to evaluating the operational effectiveness of each alternate force structure within the man in the loop CCTT simulators and Directorate of Doctrine and Training and Office Chief of Armor for the doctrinal and personnel implications.
- The operational effectiveness of each alternative was examined using both desert and a central European terrain. The choice of scenarios was constrained by available terrain and by the threat systems existing in the current data base at the Ft Knox CCTT facility. The threat in the desert scenario consisted of a Mechanized rifle company (11 BMP-2, 9 T-80 MBT, 2 Mi-24P Hind F). The central European threat consisted of approximately three Mechanized rifle companies.
(42 BMP-2, 3 T-80 MBT, 2 Mi-24P Hind F)
- The calendar for conducting this study and the run scheme for the CCTT simulations are depicted in Table 1.

Table 1. Run Scheme

Date	Alternative	AM Scenario	PM Scenario
23-Aug	4-3-3	Desert	Europe
24-Aug	3-3-4	Desert	Europe
27-Aug	4-3-3	Desert	Europe
28-Aug	3-3-4	Desert	Europe
4-Sep	4-3-3	Desert	Europe
5-Sep	3-3-4	Desert	Europe
6-Sep	4-3-3	Desert	Europe
7-Sep	3-3-4	Desert	Europe

- d. Four iterations of each alternative force structure fighting against the two scenario dependent threat forces via simulation were produced on the CCTT simulation network (See Table 1). Quantitative and qualitative data were collected both manually and by the data logger to address each of the objectives of the evaluation. To address some of the issues of command and control that would not otherwise be represented in the quantitative analysis, questionnaires were passed out to the battalion commander, the company commanders and the platoon leaders at the end of each run. The responses were accumulated into a database and used in the qualitative evaluation. Copies of the questionnaires are available in Appendix C .

7. ANALYSIS.

- a. The following measures of effectiveness (MOE) and measures of performance (MOP) were employed in the analysis of this evaluation. Measures of effectiveness were used to quantify the contributions of each alternative in terms of force effectiveness. Measures of performance were used to quantify the performance of each alternative tank platoon structure. All (Blue SAF inclusive) forces were considered (40 vehicles for 3-3-4 and 44 vehicles for 4-3-3).
- b. The MOE that was employed in this evaluation to assess force effectiveness is as follows

$$\text{Force Exchange Ratio} = \frac{\text{Loss Exchange Ratio}}{\text{Initial Force Ratio}} \quad \text{Where}$$

$$\text{Loss Exchange Ratio} = \frac{\text{Number of Red Systems Killed}}{\text{Number of Blue Systems Killed}} \quad \text{and}$$

$$\text{Initial Force Ratio} = \frac{\text{Initial Red Forces}}{\text{Initial Blue Forces}}$$

c. The following MOPs were used in this evaluation

- (1) Number of blue tanks surviving
- (2) Number of platoons repositioned (manned tank platoons only)
- (3) Number of platoon / companies combat effective
- (4) Time to reposition a platoon(manned tank platoons only)
- (5) Combat status of each tank at end of mission (manned tank platoons only)
- (6) What command and control procedures were instituted when a company or platoon became combat ineffective
- (7) Battalion frontage occupied during operation
- (8) Number of shots per manned platoon
- (9) Number of kills per manned platoon
- (10) Movement rate
- (11) Time to complete mission
- (12) Number of doctrinal manuals requiring updating at each echelon
- (13) The impacts on NCO manning for each alternative
- (14) The impacts on officer manning for each alternative

d. The force exchange ratio is shown in Figure 3. It should be restated that the FER is calculated on all vehicles in the battalion. The force exchange ratio shows the four company, three platoon with three tanks in a platoon (4-3-3) to have a higher FER than the alternative three company, three platoon with four tanks in a platoon for the desert scenario. In the much more visually constrained and heavily vegetated terrain of the central European scenario, the opposite is true with the 3-3-4 alternative having the higher FER. The difference in the desert terrain amounts to 20.7% and for the European terrain the difference is 13.7%. It is interesting to note however, that the average number of vehicles remaining in the desert scenario was exactly same for both alternatives (13) leading to the conclusion that the difference in the desert FER was a primarily function of survivability and the larger initial force size rather than a mixture of survivability and lethality. This is more clearly shown by examining the FER which mathematically becomes as follows:

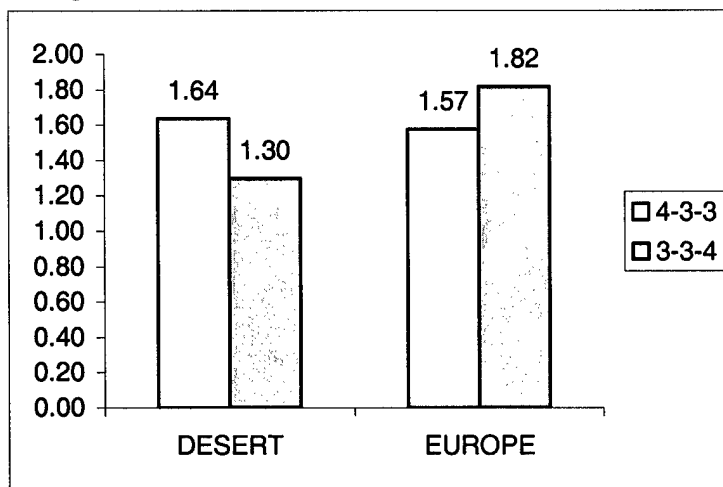
$$\left(\frac{\text{Number of Red Systems Killed}}{\text{Initial Red Forces}} \right) \left(\frac{\text{Initial Blue Forces}}{\text{Number of Blue Systems Killed}} \right)$$

Looking at it in this manner it is easier to see how only one of the two factors can influence this number since the first factor is constant for both alternatives. Then the second factor which is not dependent on lethality, completely accounts for the larger FER for the 4-3-3 alternative. The 4-3-3 alternative had an average of 33.8 vehicles remaining compared to the 28.3 vehicles remaining for the 3-3-4 alternative.

Applying this same analysis the European scenario is more difficult since both factors varied across the alternatives and a complete separation into a function of either lethality or survivability, is not possible. In the European

scenario the blue forces killed an average of 18.5 vehicles for the 4-3-3 alternative as compared to 16 for the 3-3-4 alternative. The average loss of blue vehicles for the 3-3-4 alternative was 7.5 while the 4-3-3 structure lost an average of 11 vehicles. By breaking the FER into factors that are by themselves are without meaning, it is plain to see that the only value that can account for the 3-3-4 alternative having a higher FER than the 4-3-3 alternative is the smaller number of blue systems killed. When compared to the 4-3-3 alternative, the 3-3-4 alternative has a smaller initial force size and a smaller number of red systems killed which would tend to force its FER to a smaller value and therefore those values could not have contributed to the 3-3-4 alternative having the higher FER.

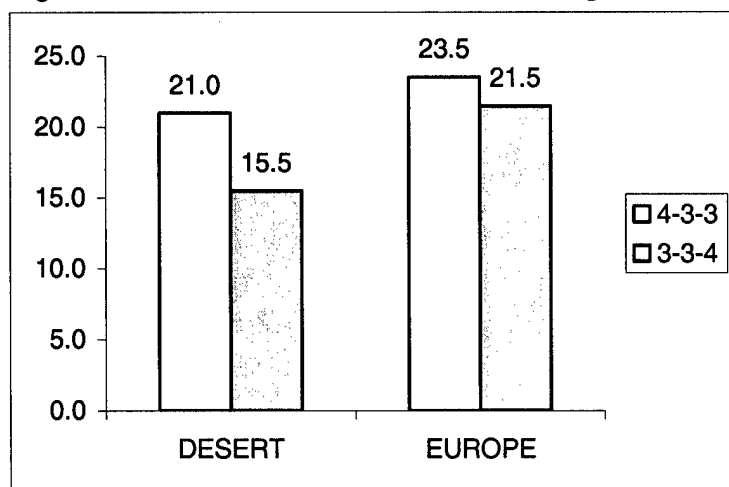
Figure 3. Force Exchange Ratio



Differences are not statistically significant

- e. Figure 4 shows the number of blue tanks remaining at the end of the mission which had not received any combat damage (fire power, mobility or catastrophic). The three tank platoon (4-3-3) is shown to be more survivable by 26.2% in the desert scenario and by 8.5% in the central European scenario than the alternative four tank platoon (3-3-4). These statistics include the SAF tank forces.

Figure 4. Number of Blue Tanks Surviving

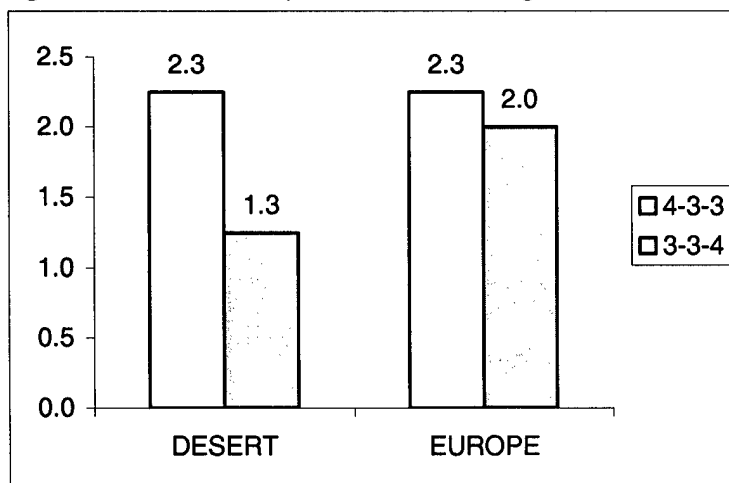


Differences are not statistically significant

f. In order to determine the number of combat effective platoons and companies the following criteria was applied; if a platoon fell below three tanks or if a company fell below six tanks, it was considered to be combat ineffective and not counted.

(1) Figure 5 shows the combat effective tank companies remaining. A comparison of the two numbers is not suitable to imply a difference in combat effectiveness since the initial number of tank companies are different. The 3-3-4 alternative initially has two tank companies and the 4-3-3 alternative has three tank companies. In the desert scenario the 4-3-3 alternative retained, on average, 1.3 combat effective tank companies and the 3-3-4 alternative retained, on average, 2.3 combat effective tank companies. In the European scenario, the 3-3-4 alternative retained, on average, 2 combat effective tank companies while the 4-3-3 alternative retained 2.3 combat effective tank companies.

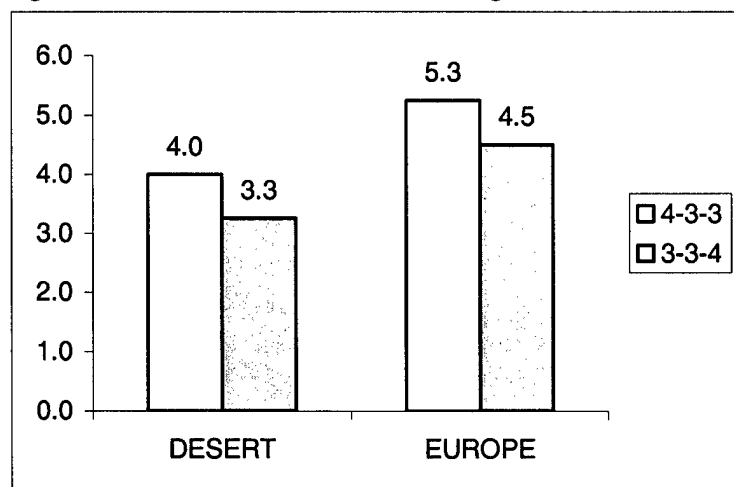
Figure 5. Tank Companies Remaining Combat Effective



Differences are not statistically significant

- (2) The same reasons that disallows direct comparison of magnitude of numbers when comparing the remaining number of combat effective companies remaining, is again true when trying to compare remaining combat effective platoons since the initial numbers are different. The 4-3-3 alternative has nine initial platoons and retains 4 of them in the desert scenario whereas the 3-3-4 alternative retains an average of 3.3 of its initial six tank platoons. The European scenario shows the 4-3-3 scenario to retain 5.3 combat effective tank platoons while the 3-3-4 structure retains 4.5 combat effective tank platoons.

Figure 6. Tank Platoons Remaining Combat Effective



Differences are not statistically significant

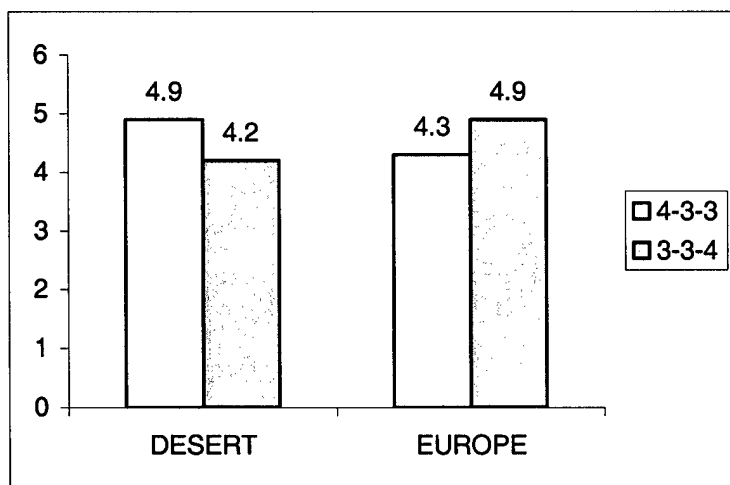
The numbers as presented in Figure 5 and Figure 6 represent only the number of maneuver elements that remain at the platoon or company level. In either scenario, it remains true that the 4-3-3 alternative, on average, ended with more remaining maneuver units at the company or the platoon level.

- (3) To determine the effect of recombining remnants of a platoon or company on the agility of a unit requires the recording of what command and control procedures would be instituted when a company or platoon became combat ineffective and the time that this action would require. In order to capture command and control procedures the company and battalion radio nets were monitored. The recording of the time to reposition a platoon or company would begin upon the issuing of the command and control procedures to be followed. The time recording would then stop when the action that was ordered was complete or became unobtainable. The commanders were not under any instructions to maintain combat effective units. There was not, in the course of this study, any action taken upon a combat element becoming ineffective. To take the data and mathematically recombine the remnants of the elements would be meaningless without the rest of the effects being

represented.

- g. Measurements were taken a various times during the simulation runs in order to determine the battalion frontage. It was a strictly linear measurement from the furthest extents of the battalion without regard to density or to the depth of the dispersion. A difficulty in making this measurement was that it required the forces to be arrayed in a formation such that it was possible to draw a line from one extremity to the other about which it could be said that most of the forces were to center around. The maximum distance that could be occupied was pre-defined by the boundaries of the operation so all results are less than or equal to the extent of the boundaries of the taskforce operation. The measurement was recorded two or three times during each run and an attempt was made to measure the linear dispersion of the battalion at its widest point. The result indicates, that in the desert, that the three tank, four company alternative (4-3-3) had a 14.3% wider dispersion over the three company four tank platoon (3-3-4). In the European scenario, Figure 7 shows the 3-3-4 alternative to have occupied a 12.2% wider frontage. In both cases, the difference in the overall average was less than one kilometer.

Figure 7. Battalion Frontage

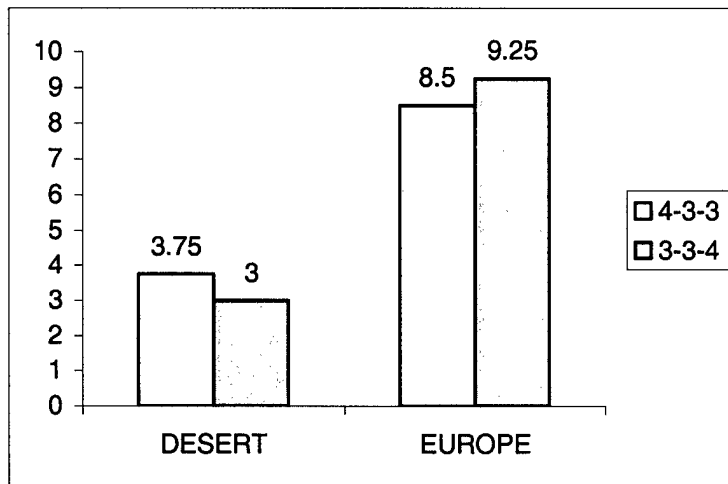


Differences are not statistically significant

- h. The number of kills by the manned tank platoon includes only the tank company in the manned simulators. The SAF forces in CCTT detects targets and fires on targets at the pre-set maximum range with the success of the firing being largely a function of the marksmanship level set prior to the simulation execution. For the reason previously stated, data was collected on the performance of the manned tank platoons. Dismounted forces killed by the tank company are not included in this calculation and all vehicles are equally weighted as one. In the CCTT three types of kills are possible and they are as follows: mobility, firepower and catastrophic. What can and does occur is that a vehicle can first receive a mobility or a

firepower kill and then receive another type of kill by the same or by a different tank. The type of kill is also equally weighted and only the initial kill is counted. The results show the four company three tank platoon (4-3-3) to have slightly more kills than the alternative 3-3-4 structure in the desert while the opposite is true for the European scenario. It should be noted that there were 47 countable targets in the European scenario compared to 22 in the desert scenario.

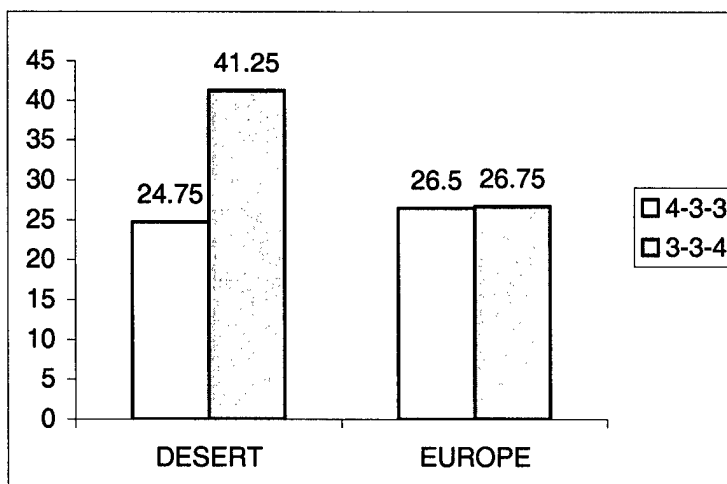
Figure 8. Manned Tank Company Kills



Differences are not statistically significant

- i. The rounds fired by manned tank platoon includes only the 120mm tank ammunition. It is not an indication of the accuracy or the effectiveness of the firing since multiple kills against a single target, as well as misses, are possible. It is used primarily as a metric to measure the massing of fires. Figure 8 shows the three company four tank platoon (3-3-4) to have fired 40% more rounds than the 4-3-3 alternative in the desert scenario and about the same in the European scenario.

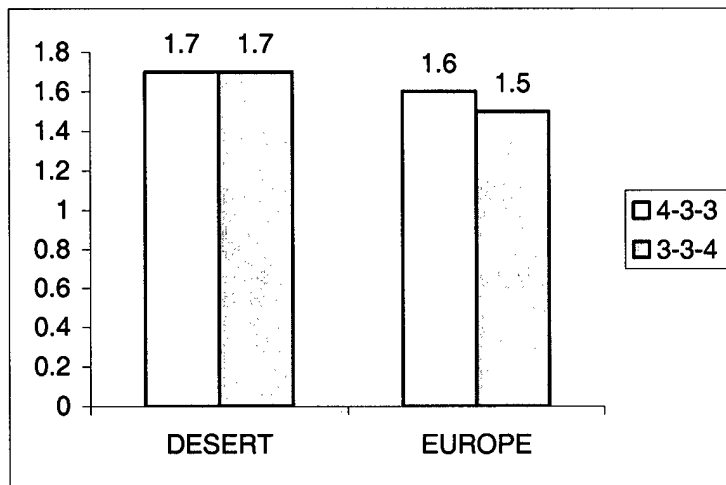
Figure 9. Shots Fired by Manned Platoon



Differences are not statistically significant

- j. The time to complete mission recording was started once the tank crews had finished their radio checks and the taskforce commander had given the order to move. The data recording would have ended in the desert scenario at 16 blue losses or 11 red losses and at 24 red losses and 16 blue losses for the European scenarios. Figure10 shows both alternatives to be roughly equal.

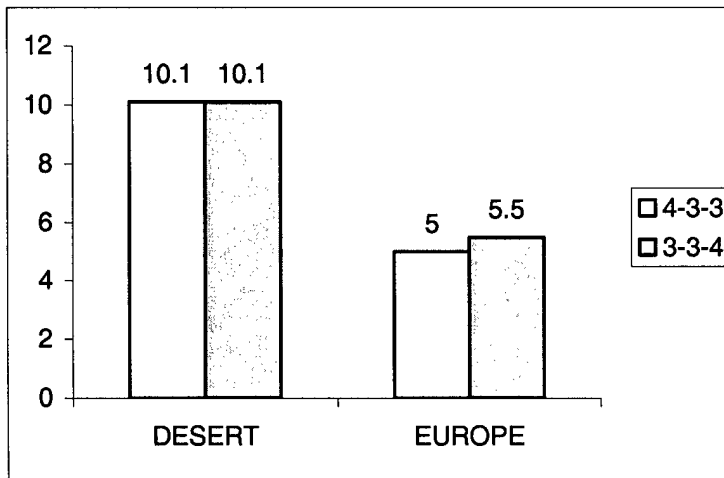
Figure 10. Time to Complete mission



Differences are not statistically significant

- k. Movement rate was simply the distance traveled divided by time to complete mission. The threat mission was a deliberate defense and their battle positions did not vary a great deal. Since the distance that was traveled was relatively constant and the time to complete mission was also fairly constant there was little difference in the movement rate by either alternative.

Figure11. Movement Rate



Differences are not statistically significant

I. The scenarios were designed so that the manned tank company was placed in the most difficult portion of the battle. This is reflected in Table 2 through Table 5 where M denotes a mobility kill, F is a fire power kill, and K is a catastrophic kill. Also to be noted from tables is the wide amount of variation that was typical in this evaluation.

- (1) The tables show that in the desert scenario, the four company three tank per platoon (4-3-3) lost on average 5 tanks compared to an average of 8.75 tanks for the 3-3-4 alternative and in the European scenario the 4-3-3 alternative lost on average 3.5 tanks compared to an average of 3.75 for the 3-4-4 structure. In both scenarios the 4-3-3 alternative lost fewer tanks with the biggest difference occurring in the desert scenario.
- (2) In order to average the 120mm rounds remaining, the following criteria was applied: if a tank was neither a firepower nor a catastrophic kill, its remaining 120mm rounds were summed and divided by the total number of tanks within the company that could still fire (mobility kills are included).
- (3) In the desert scenario, the 120mm rounds remaining, average to 34.7 rounds remaining per tank that is able to fire for the 3-3-4 alternative compared to an average of 37.1 for the 4-3-3 alternative. This yields less than a 6.5% difference in the desert scenario. The European scenario averages to 37.4 rounds for the 3-4-4 alternative and 35.9 for the 4-3-3 alternative which is about a 4% difference. In both cases, there is little difference in the number of rounds remaining.

Table 2. 3-3-4 Desert Ending Combat Status

		23-Aug		27-Aug		4-Sep		6-Sep			AVG # A CO all runs
Bumper	Vehicle	Status	Ammo	Status	Ammo	Status	Ammo	Status	Ammo	Status	
3-32AR A 0	M1A2		35		39		22		36	M	1
3-32AR A11	M1A2	MF		MF		K		M	40	MF	5.5
3-32AR A12	M1A1 Abrams	MF		MF		MF			40	F	0.75
3-32AR A13	M1A1 Abrams		32	K		MF		K		K	1.5
3-32AR A14	M1A2	K		K		M	40		16	Total	8.75
3-32AR A21	M1A2	MF			31	MF		MF		FMC	1.25
3-32AR A22	M1A1 Abrams	MF		M	28	M	40	MF			
3-32AR A23	M1A1 Abrams	MF			40	MF		M	40	Ammo	34.6
3-32AR A24	M1A2		36	MF		F		MF		rds per tank	
3-32AR A31	M1A2	MF		MF			37	MF			
3-32AR A32	M1A1 Abrams	K			40		37	MF			
3-32AR A33	M1A2	MF			31	F		MF			
3-32AR A34	M1A2	MF			39		30	F			
A rounds left			103		248		206		172		
rds per tank			34.3		35.4		34.3		34.4	Sum	139.4

Table 3. 4-3-3 Desert Ending Combat Status

		24-Aug		28-Aug		5-Sep		7-Sep			AVG # A CO all runs
Bumper	Vehicle	Status	Ammo	Status	Ammo	Status	Ammo	Status	Ammo	Status	
3-32AR A 0	M1A2	M	29	K		K		K		MF	2
3-32AR A11	M1A2		38	MF			40	K		F	0
3-32AR A12	M1A1 Abrams		40		35	M	38	MF		K	3
3-32AR A14	M1A2	MF		MF			40	K		Total	5
3-32AR A21	M1A2	M	40		31	MF		K		FMC	5
3-32AR A22	M1A1 Abrams		37		40		36	K			
3-32AR A24	M1A2		39		38	MF		K		Ammo	37.1
3-32AR A31	M1A2		37	MF		M	39	K		rds per tank	
3-32AR A32	M1A1 Abrams		33		39	K			36		
3-32AR A34	M1A1 Abrams		40	MF		K		K			
A rounds left			333		183		193		36		
rds per tank			37.0		36.6		38.6		36	Sum	
										148.2	

Table 4. 3-3-4 Europe Ending Combat Status

		23-Aug		27-Aug		4-Sep		6-Sep			AVG # A CO all runs
Bumper	Vehicle	Status	Ammo	Status	Ammo	Status	Ammo	Status	Ammo	Status	
3-32AR A 0	M1A2		39		26		31	K		MF	2.25
3-32AR A11	M1A2		40		40	K		K		F	0.75
3-32AR A12	M1A1 Abrams		40		39		40		40	K	0.75
3-32AR A13	M1A1 Abrams		39		39	MF			33	Total	3.75
3-32AR A14	M1A2	MF			39		36	MF		FMC	6.25
3-32AR A21	M1A2		40	MF			38	MF			
3-32AR A22	M1A1 Abrams		40		28	M	35	MF		Ammo	37.4
3-32AR A23	M1A1 Abrams		40	M	40	MF		MF		rds per tank	
3-32AR A24	M1A2		40		40	F			35		
3-32AR A31	M1A2		40		36		39		37		
3-32AR A32	M1A1 Abrams		39		38	F			34		
3-32AR A33	M1A2		40		40	F			40		
3-32AR A34	M1A2		38		40	M			36		
A rounds left			475		445		219		255	Sum	
rds per tank			39.6		37.1		36.5		36.4	149.6	

Table 5. 4-3-3 Europe Ending Combat Status

		24-Aug		28-Aug		5-Sep		7-Sep			AVG # A CO all runs
Bumper	Vehicle	Status	Ammo	Status	Ammo	Status	Ammo	Status	Ammo	Status	
3-32AR A 0	M1A2		35		40		40	MF		F	0.25
3-32AR A11	M1A2	MF		MF			40	K		K	1.5
3-32AR A12	M1A1 Abrams		37		35		40	MF		Total	3.5
3-32AR A14	M1A2		35		36		39	K		FMC	6.5
3-32AR A21	M1A2	MF			40	F			28		
3-32AR A22	M1A1 Abrams	M	35	K	39		40	MF		Ammo	35.9
3-32AR A24	M1A2		32				40	MF		rds per tank	
3-32AR A31	M1A2		40		34		26	M	38		
3-32AR A32	M1A1 Abrams		40		39		40		30		
3-32AR A34	M1A1 Abrams		32	K			40	K			
A rounds left			286		263		345		96	Sum	
rds per tank			35.8		37.6		38.3		32.0	143.7	

8. DOCTRINAL ASSESSMENT.

The doctrine assessment found the adoption of a four company battalion (4-3-3) would require a rewrite on the following manuals; FM 3-20.15 – Tank Platoon FM 3-90-1 – Tank and Mechanized Infantry Company Team and FM 3-20.12 Tank Gunnery (Abrams). The changes required would be a result of the following factors: a platoon would become the lowest element of maneuver, platoon C2 is easier, the freedom of maneuver within the platoon is lost and the company would maneuver by platoon bounding-over watch. In the case of 3-3-4 it was found that the following doctrinal manuals would have to be changed: FM 3-90-2 – Tank and Mechanized Infantry Task Force, FM 3-90.3 – Armored and Mechanized Infantry Brigade.

9. LEADERSHIP / SOLDIER ASSESSMENT.

- a. The impact on leadership evaluation finds that the following changes would occur if the four company 4-3-3 alternative would be adopted. The conversion to a 4 tank company structure, will increase the Armor Branch's ability to branch qualify captains as company commanders. The conversion would also increase the branch's ability to grow branch qualified CPT's and fill critical Army requirements. The conversion may also require an increase in annual accessions to fill the additional 81 XO and platoon leader positions. The projected changes are reflected in table 6.

Table 6 Leadership Requirements

	Captain Branch Qualified OPP RATE	Annual Branch Qualified Captain Production
Current (3 Tank Co)	96%	NC
Proposed (4 Tank Co)	104%	18

- b. The impact of adopting the four company three tank platoon on the NCO Corps, is that the addition of one company (4-3-3) would increase by 3 the required E-7 positions and by 1, the number of required of E-8 positions. The increased requirement in the E-7 positions would occur at the same time that the loss of one tank in the platoon would decrease by 5 the pool from which to promote platoon sergeant. This would require all the E-7s would be drawn from a pool that would have a 1.13 ratio of E-6s to E-7s as compared to the 3-3-4 which has a current ratio of 1.83 times as many E-6s to E-7. This problem or choke point is illustrated in Figure 11 and Figure 12. One solution would be to authorize the company XO and Bn CMDR tank commander at the E-6 level. This would standardize the entire battalion tank commanders to an E-6 level and maintain the current ratio of E6s to E7s at its current 1.83 ratio.

Figure 12. Current NCO Progression Pyramid (3-3-4)

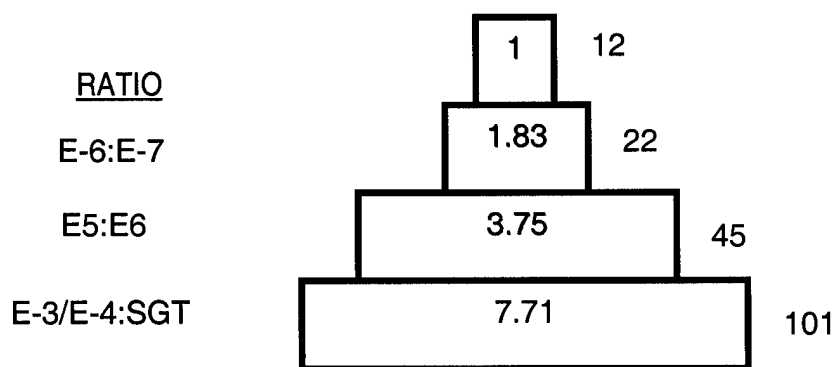
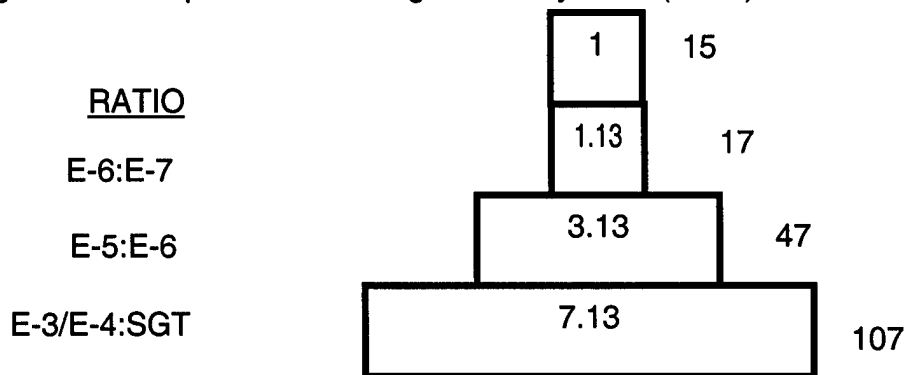


Figure 13. Proposed NCO Progression Pyramid (4-3-3)



10. CONCLUSION.

The lack of experience present in the crews resulted in wide variations in results and when this was combined with the small number of iterations constrains the amount of information that can be derived from these results. This evaluation showed the two alternatives to be almost equal with the exception of the difference in the survivability of the tank platoons for the 4-3-3 alternative in the desert scenario.

- When comparing most of the results by looking at the difference in the magnitude of the results, most differences were small.
- The three company alternative was able to mass more fire power in the desert scenario but the alternatives were equal in the European scenario.
- The 3 tank platoon in the 4-3-3 alternative was more survivable in the desert scenario.
- The momentum for both alternatives was approximately the same.
- The frontage occupied for both alternatives was approximately the same.
- For both alternatives the average number of vehicles killed by the manned simulators differed by less than 1 vehicle.

- RECOMMENDATION. A change in the force structure from the current 3-3-4 to the alternative 4-3-3 is not warranted based solely on the results of this evaluation. The use of CCTT as an evaluation tool provides insights into command and control aspects that warrant its use in any future examination of this issue.

Appenix A. CCTT REPORT HEADERS

CCTT Automated Data Logger

1. There are 10 total reports of which 9 were deemed to be useful in this evaluation (copies of field headers are on the following pages)
2. The reports must be independently updated for each side played and the updates must occur just before the gathering of data onto a medium suitable for storage.
3. The reports are generated at machine execution time and are not archived. They must be gathered before the scenario is ended.
4. The file is spooled to the ASCII text file at update time but is overwritten upon the next generation of the same scenario (or any scenario with the same name).
5. An Unix script file was used to gather all files into container files at approximately the same machine time
6. Data was copied to a 3 1/2" floppy diskette using the equipment present in the AAR room at the CCTT facilities in Ft Knox KY
7. All data including voice transmissions can be archived. (the ability to generate the report files is archived)
8. To recover data off of an archive, the playback must run until the desired machine time.
9. The direct fire report is large, it must be compressed to fit on a 1.4M disk
10. If Microsoft Excel is the reduction tool, some misalignment of the data fields will occur.

Report 10: Personnel Casualties**REPORT OPTIONS:**

Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:14:54

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:22:24

Target	Description	Personnel
--------	-------------	-----------

Report 09: Damage**REPORT OPTIONS:**

Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:14:40

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:22:10

Damaged Vehicle	Vehicle Description	Vehicle Damage	Time of Damage	Vehicle Location	Damage Cause
-----------------	---------------------	----------------	----------------	------------------	--------------

Report 08: Close Air Support**REPORT OPTIONS:**

Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:14:35

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:22:05

Mission Number	Time of Fire	Firing Vehicle	Vehicle Description	Target Vehicle	Vehicle Description	Target Damage	Target Range
----------------	--------------	----------------	---------------------	----------------	---------------------	---------------	--------------

Mission Number	Mission Requester	Fire Total	Hits Total	Misses Total
----------------	-------------------	------------	------------	--------------

Report 07: Minefields

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:21:38

REPORT OPTIONS:

Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:14:07

Minefield Number	Mine Count	Friendly Entries	Friendly Kills	Enemy Entries	Enemy Kills
---------------------	---------------	---------------------	-------------------	------------------	----------------

Total Minefields

Report 06: Ammunition Expenditure

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:21:31

REPORT OPTIONS:

Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:14:01

Ammunition

Rounds	Firing Vehicle	Firing Vehicle Description
--------	-------------------	-------------------------------

Report 05: Weapon/Ammunition/Kill Crosswalk

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:21:24

REPORT OPTIONS:

Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:13:54

Weapon

Ammunition	Target Description	Count	Damage
------------	--------------------	-------	--------

Report 04: Indirect Fire

Exercise ID: 1
Exercise Start Date: 23AUG01
Simulation Start Date: 07JUN99
Created On: 23AUG01 14:21:15

REPORT OPTIONS:
Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 07JUN99 08:04:37
Time Frame End: A 07JUN99 11:13:45

Mission Number	Firing Vehicle	Vehicle Description	Fired Ammunition	Fired Rounds	Target Bumper	Target Description	Target Damage
----------------	----------------	---------------------	------------------	--------------	---------------	--------------------	---------------

Mission Number	Mission Requester	Fire Total	Rounds Total	Fire % Effective	Fire % Ineffective
----------------	-------------------	------------	--------------	------------------	--------------------

Report 03: Direct Fire

Exercise ID: 1
Exercise Start Date: 28AUG01
Simulation Start Date: 01JUN99
Created On: 28AUG01 18:38:24

REPORT OPTIONS:
Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 01JUN99 08:10:19
Time Frame End: A 01JUN99 10:02:57

Time	Firing Vehicle	Weapon	Ammunition	Detonation	Target	Range	Damage
------	----------------	--------	------------	------------	--------	-------	--------

Report 01: Firing Vehicle - Target Scoreboard

Exercise ID: 1
Exercise Start Date: 28AUG01
Simulation Start Date: 01JUN99
Created On: 28AUG01 18:38:18

REPORT OPTIONS:
Force: BLUFOR
Unit: ALL
Vehicle: ALL
Time Frame Start: A 01JUN99 08:10:19
Time Frame End: A 01JUN99 10:02:52

BLUFOR Firing Bumper Number	Vehicle Description	OPFOR Target Description	Count	Damage
-----------------------------	---------------------	--------------------------	-------	--------

Appendix B. Historical Bibliography

3 Vehicle vs. 4 Vehicle Mechanized/Armor Platoon Structure, Tradoc Analysis Center and National Training Center , Fort Knox and Fort Benning; 16 March 1998.

Division Restructuring Study (DRS)--Brigade Evaluation Phase III Organization Development Volume 2, Fort Hood, Texas August 31, 1979.

Decremental Maneuver Battalion Capability Study, Potomac Systems Engineering for TRAC-FLVN, June 8 1990.

Restructuring of the Heavy Division Phase II, Tradoc Combined Arms Test Activity, May 1979

A Dynamic Analysis of the Medium Tank Battalion, Center for Advanced Research, Naval War College, June 1978.

M1A2 Tank Battalion Organization, Army Command and General Staff College, Leavenworth KS, Dec 1995.

History of Army 86 Vol 1 The Development of the Heavy Division, John Romjue, Historical Office US Army Training and Doctrine Office, June 1982.

Three Tank Platoon versus Five tank Platoon. TRADOC Combined Arms Test Activity, Fort Hood TX, Nov 1976.

Appendix C Questionnaires

BATTALION QUESTIONNAIRE

Scenario _____ **Force Structure** _____ **Date** _____

1. Did the force structure help or hinder your ability to accomplish the mission? In what way?

2. Did the force structure assist or detract from your ability to plan for this mission? In what way?

3. How would you have planned differently with the other force structure?

4. Were you impacted by the force structure in your ability to execute your plan? In what way?

5. Did the force structure aid or hurt you in reacting to threat actions/counteractions? In what way?

6. Were there aspects of the force structure that enhanced or hindered your ability to exercise battle command (includes assigning missions, prioritizing and allocating resources, selecting the critical time and place to act and knowing how and when to make adjustments during the fight) during this exercise? What were they?

7. What impact did the force structure have on operations during this mission?

8. Was the force structure sufficient to permit the assault of the enemy positions? If not, what additional assets are required?

9. Did you have sufficient forces remaining to defend your position and carry out any follow-on missions? Please specify what follow-on missions you could have executed.

10. What other observations do you have regarding the impact of the battalion structure/size on your mission success during this exercise?

Scenario_____ **Force Structure**_____ **Date**_____

Company_____

Date_____

1. Did the force structure help or hinder your ability to accomplish the mission? In what way?

3. Were you impacted by the force structure in your ability to execute your plan? In what way?

4. Did the force structure aid or hurt you in executing maneuver? In what way?

5. Was there an impact on operations due to the loss of platform(s) within the company? What were they?

6. What impact (if any) did the force structure have on your ability to conduct actions on contact during this mission?

7. Were there any difficulties in the assault of the enemy positions? If so, what were they?

8. Did you have sufficient forces remaining to defend your position and carry out any follow-on missions? Please specify what follow-on missions you could have executed.

9. What other observations do you have regarding the impact of the company structure/size on your mission success during this exercise?

Scenario _____ Force Structure _____ Date _____
Platoon _____

4. During the exercise was your platoon required to reorganize either by joining another platoon or having another platoon's assets placed under your control? If so, why and what was the impact of this reorganization/restructure?

5. Once in contact did you fight the platoon or your individual tank? Did platoon size/structure have any impact on your decision? Explain.

6. Were the TTPs adequate to conduct your assigned mission given the platoon structure/size for this exercise? If not what changes are required to the TTPs?

7. Given the platoon structure/size for the exercise, at what point did your platoon become combat ineffective (1 loss, 2 losses, 3 losses) and why?

8. What other observations do you have regarding the impact of the platoon structure/size on your mission success during this exercise?